

**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
TWENTY FIRST CENTURY SCIENCE  
SCIENCE A**

**A213/02**

Unit 3 Modules B3 C3 P3  
(Higher Tier)

Candidates answer on the question paper  
A calculator may be used for this paper

**OCR Supplied Materials:**  
None

**Other Materials Required:**

- Pencil
- Ruler (cm/mm)

**Monday 19 January 2009  
Morning**

**Duration: 40 minutes**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

**INFORMATION FOR CANDIDATES**

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **42**.
- This document consists of **20** pages. Any blank pages are indicated.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
1	4	
2	4	
3	6	
4	2	
5	5	
6	7	
7	4	
8	6	
9	4	
<b>TOTAL</b>	<b>42</b>	

Answer **all** the questions.

- 1 Brenda has not been feeling well. Her doctor wants her to have a gamma scan to check whether her kidneys are working properly.

For this scan, a radiologist will inject a radioactive chemical called technetium-99m into Brenda. Technetium-99m gives off gamma radiation and has a half-life of 6 hours.


Brenda will be staying in hospital for a few days. She is very anxious about the gamma scan.

**Brenda**

I've heard that gamma radiation is dangerous. Is it possible that this treatment could give me cancer?

When I get home again, won't I be dangerous to be near if I've got radioactive chemicals in me?

I see that the radiologist wears protective clothing. Why is it needed if the chemicals are safe enough to inject into my body?



Which of the following statements could the doctor say to best answer each of Brenda's questions?

- (a) "I've heard that gamma radiation is dangerous. Is it possible that this treatment could give me cancer?"

Put a tick (✓) in the box next to the **one** best statement.

Only alpha radiation and beta radiation cause cancer.

Gamma radiation is used to cure cancer, so it can't be bad for you.

The benefit you get from an accurate diagnosis makes the slight risk of cancer worthwhile.

Gamma radiation goes straight through matter, so it will all pass out of your body without causing any damage.

[1]

- (b) “When I get home again, won’t I be dangerous to be near if I’ve got radioactive chemicals in me?”

Put ticks (✓) in the boxes next to the **two** correct reasons the doctor could give Brenda to explain why she will not be a danger to her family.

The radioactivity of the technetium-99m becomes very small within a few days.

Immediately after the gamma scan is over, the radioactive chemical stops being radioactive.

The gamma radiation will all be absorbed by your body, so there is no risk to your family.

When the treatment is over, the technetium-99m is chemically treated and stops being radioactive.

Your family are not as close to the source of radiation as you are, so they will have a much smaller dose than you.

[2]

- (c) “I see that the radiologist wears protective clothing. Why is it needed if the chemicals are safe enough to inject into my body?”

Put a tick (✓) in the box next to the **one** best reason the doctor could give Brenda.

The protective clothing is part of the hospital’s uniform.

The protective clothing stops all the gamma radiation from reaching the radiologist.

There are Government regulations which make radiologists wear protective clothing.

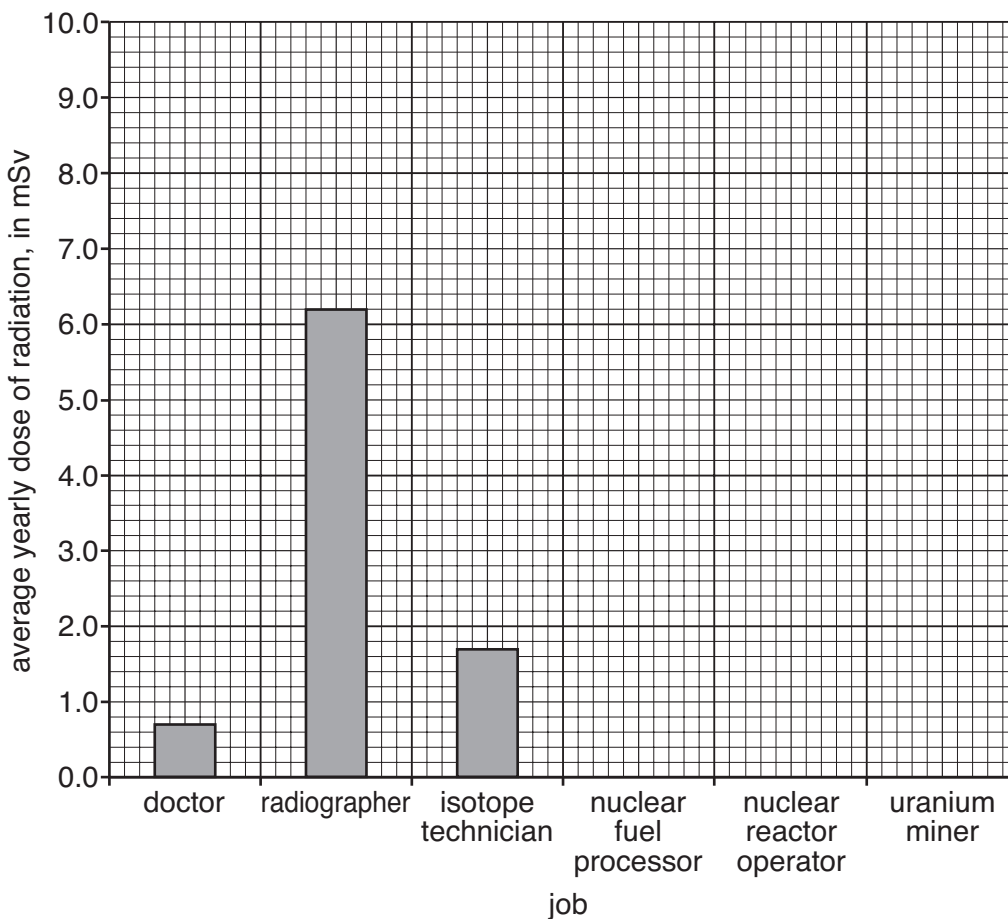
Unlike patients, radiologists use radioactive chemicals every day. Protective clothing keeps the risk to them within safe limits.

[1]

[Total: 4]

- 2 The table and bar chart show the average yearly dose of radiation for seven different jobs where people work with radioactive materials. The bar chart is incomplete.

job	average yearly dose in mSv
doctor	0.7
radiographer	6.2
isotope technician	1.7
nuclear fuel processor	2.9
nuclear reactor operator	2.2
uranium miner	9.6



(a) (i) Use the table to complete the bar chart. [1]

(ii) Write down the range of average yearly doses for these jobs.

..... to ..... mSv [1]

- (b) When a group of nuclear reactor operators had their average yearly dose measured, the following results were obtained.

average yearly dose in mSv						
Adel	Brian	Chloë	David	Elmira	Frank	Grant
2.1	2.3	1.9	2.2	2.1	2.0	7.0

All of the operators worked the same number of hours in similar working conditions.

Use the data in the table to find the best estimate of the average yearly dose for the nuclear reactor operators.

Show your working in this space.

best estimate = ..... mSv [2]

[Total: 4]

- 3 A government minister says that more nuclear power stations should be built.



**Government Minister**

New nuclear power stations could make a significant contribution to meeting our energy policy goals. Using nuclear power means we can generate electricity without carbon emissions. It provides energy all the time, which wind power cannot.

The spokesman for an environmental group disagrees with the government minister.

**Environmental Group Spokesman**

Nuclear power is dangerous and expensive. We must stop climate change, but we don't need nuclear reactors to do this. We need to use more renewable sources to reduce carbon dioxide emissions.



- (a) Each of the following statements is true.

For each statement, put ticks in the correct boxes to show whether it supports the government minister or the environmental group spokesman.

Each statement may have one tick, two ticks or no ticks at all.

statement	supports the government minister	supports the environmental group spokesman
Nuclear power stations do not produce carbon dioxide while they are working.		
An accident at a nuclear power station could result in the release of radioactive materials.		
Increase in carbon dioxide in the atmosphere is almost certainly responsible for global warming.		
Fossil fuels such as gas are running out and becoming much more expensive.		

[4]

- (b) Nuclear power stations and wind farms have some similarities and some differences. From each box on the left, draw lines joining it to **each** box on the right which correctly describes it.

Each box on the left may be joined to one, two or more boxes on the right.

Nuclear power station

Carbon dioxide is produced when it is being built.

Design of this power station involves the use of a coolant.

Electricity is generated by a generator turned by a turbine.

Wind farm

It does not have to be taken apart at the end of its use.

There are no fuel costs.

[2]

[Total: 6]

4 This is a question about theories.



Trofim Lyenko was an agricultural scientist in the Soviet Union, which later became modern Russia.

He said that his experiments showed that organisms could pass on characteristics they had developed in their lifetime.

In the 1920s, the Soviet Union strongly supported Lyenko's work, which promised to produce much more wheat to feed the people. By 1964 the Soviet Union had abandoned Lyenko's theory.

Here are some of the reasons why the Soviet Union abandoned Lyenko's theory.

Put ticks (✓) in the boxes next to the **two** best **scientific** reasons.

Lyenko's results could not be repeated.

The new leader of the Soviet Union wanted to make changes.

Lyenko's theory dated from fifty years ago and was out-of-date.

Breeding experiments with wheat showed that only genetic variation can be passed on.

Other countries that did not use Lyenko's theory were growing more crops.

[2]

[Total: 2]



5 This question is about the maintenance of a constant internal environment in the body.

(a) (i) What is the scientific term for the maintenance of a constant internal environment?

answer ..... [1]

(ii) Both the nervous and hormonal communication systems are involved in maintaining this constant internal environment.

Put ticks (✓) in the boxes to indicate which statements are true for the **nervous system**, which are true for the **hormonal system**, and which are true for **both systems**.

statement	nervous system only	hormonal system only	both systems
use electrical impulses			
use chemicals which travel in the blood			
produce short-lived responses			
produce slow responses			
have receptor cells			

[3]

(b) In humans and other vertebrates, the nervous system is co-ordinated by the central nervous system.

What are the two main parts of the central nervous system?

answer ..... and ..... [1]

[Total: 5]

6 This is a question about evolution.

The picture shows a clouded leopard.



Read the article about clouded leopards.

1. There has been new research into clouded leopards on the island of Borneo.
2. Until this research, clouded leopards in Borneo and in mainland Asia were thought to be the same species.
3. However, DNA analysis showed there were 40 genetic differences between clouded leopards from Borneo and clouded leopards from mainland Asia.
4. Some scientists now think that these two species of clouded leopards are different because they have evolved separately for a long time.

(a) Statement 4 is a scientific explanation of the results of the research.  
Put a tick (✓) in the box next to the **best** reason for accepting this explanation.

Statement 4 makes predictions which can be tested.

Statement 4 accounts for all the data already known.

Statement 4 explains a wide range of observations.

Statement 4 was thought up imaginatively to account for some of the data.

[1]

(b) The article continues:

The fact that Borneo’s top predator is now considered a separate species emphasises the need for **sustainable** development of the island which has a particularly high **biodiversity**.

Use straight lines to join each **term**, sustainable and biodiversity, to its correct **definition**.

<b>term</b>	<b>definition</b>
	the variety of living things within and between species
sustainable	using resources in the best and most profitable way
biodiversity	using resources so that they can continue to be used in the future
	the gradual change of a population over time

[2]

(c) (i) Mutations can occur in all types of cells.  
 For some cells, this mutation can be inherited.  
 Write down the name of the type of cell where this can happen.

type of cell ..... [1]

(ii) Natural selection would not occur if all individuals in a population were identical.

Put a tick (✓) in the box next to the **best** explanation for this.

- All individuals would breed asexually.
- All individuals would survive.
- There would be no competition.
- There would be no gene mutation.
- All individuals would compete equally well.

[1]

(d) In a biology class four students are discussing how natural selection may have produced the two species of clouded leopard from a common ancestor.

**Chloe**  
Both leopards live in trees and are predators.

**Zoe**  
The two populations of leopards couldn't interbreed.

**Brian**  
The two populations will have had different mutations.

**Mark**  
The environment in Borneo must have been different from that in mainland Asia.

(i) Which two students are stating why the two populations of leopards may become **genetically** different?

answer ..... and ..... [1]


(ii) Which student **best** explains why natural selection has acted differently for the two populations of clouded leopards?

answer ..... [1]


[Total: 7]

7 Some people in a supermarket are talking about buying organic food.


**Gemma**  
I always wash fruit and vegetables well. This gets rid of the chemicals they have been sprayed with.




**Emily**  
Organic farmers recycle nutrients so there isn't any waste.



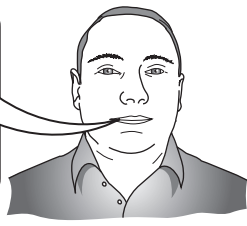
**Sally**  
The Food Standards Agency says there is no evidence that organic food is better for you.



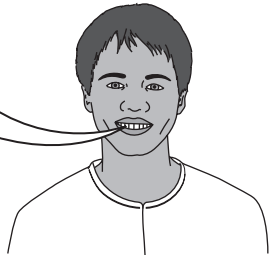
**Shaun**  
Organic food is good for the environment because farmers are not allowed to use pesticides or synthetic fertilisers.



**Sam**  
Organic food is healthy. The farmers have to follow the rules of the Soil Association.



**Ali**  
I buy non-organic food. It may have some chemicals on it, but organic food is far too expensive.



(a) Which two people are talking about organisations which regulate the standard of food production?

answer ..... and ..... [1]

(b) Who has explained why organic farming is sustainable?

answer ..... [1]

(c) Who has given a reason to accept a risk?

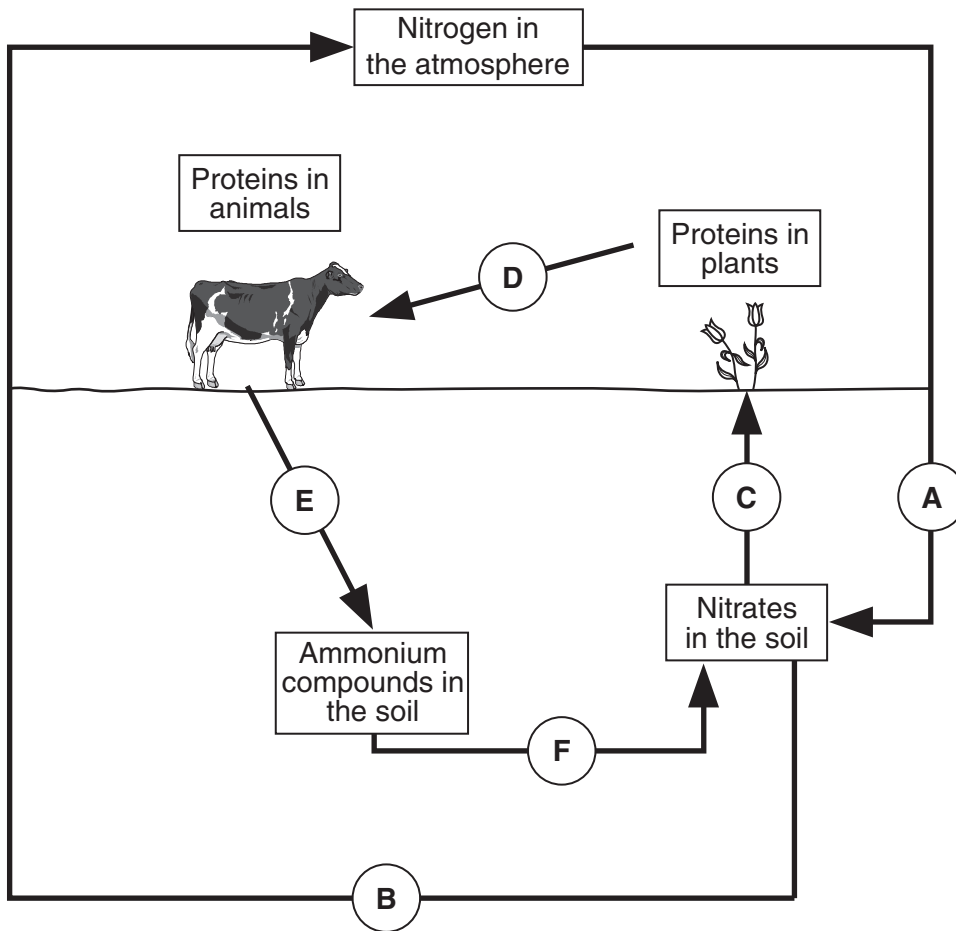
answer ..... [1]

(d) Who refers to the pollution caused by intensive farming?

answer ..... [1]

[Total: 4]

- 8 This is a question about the nitrogen cycle.  
The nitrogen cycle is shown in the diagram below.



- (a) All proteins contain nitrogen and three other elements.  
Write down the names of these **three** other elements.

answer ..... and ..... and ..... [2]

- (b) A, B, C, D, E and F are all processes in the cycle of nitrogen atoms on the Earth.

- (i) Write down the **letters** of **three** processes in the cycle that involve bacteria.

answer ..... and ..... and ..... [2]

- (ii) Write down the **letter** of the process in the cycle that involves the formation of amino acids.

answer ..... [1]

- (c) Nitrogen compounds are removed from the soil when crops are harvested. Farmers need to replace this nitrogen to grow more crops. Put a tick (✓) next to **each** method that an **organic** farmer could use.

Dig in a powder containing ammonium compounds.

Dig in manure.

Spread compost and dig in.

Grow leguminous crops such as clover.

Sprinkle granules made of nitrates.

[1]

[Total: 6]

- 9 Read this newspaper article about preservatives in food.

### WATCH WHAT YOU EAT

Preservatives are often added to food, but watch the ones you eat.

Microorganisms cannot grow in food that is too sweet, too salty or too acidic. Sugar, salt and vinegar have been used for centuries to preserve food. Although salt and sugar are now linked to health problems, small amounts of them won't harm you.

This may not be true for modern preservatives. The Food Standards Agency has reported that sodium benzoate (E 211) can make symptoms of asthma and eczema worse in children that already have these conditions.

- (a) Read the sentences below about adding chemicals to food. Which **two** when put together explain the function of **preservatives**? Put ticks (✓) in the boxes next to the **two** correct answers.

They improve the taste of food.

They stop the growth of harmful microorganisms.

Labels show what is added to food.

They stop the food reacting with oxygen in the air.

They keep food safe for longer.

Additives with E numbers have passed a safety test.

[2]



- (b) Scientists have carried out a risk assessment for the Food Standards Agency. They estimate the risk in chemicals that people may eat.

Which **three** of the statements below when **put together** explain what scientists include in a risk assessment?

Put ticks (✓) in the boxes next to the **three** correct statements.

How many foods contain the chemical.

Whether anyone will choke on the food.

How much harm the chemical may cause.

Whether the chemical is natural or artificial.

The cost of replacing the chemical with an alternative.

Whether some people are more affected than others.

How likely it is that people will suffer harm from the chemical.

[1]

- (c) Sadie and Tom have children who suffer from asthma.

They often discuss the effect of different foods on their children.

Here are some of the things they said after reading the newspaper article.

**A** There isn't anything we eat or drink that is risk free.

**B** Food labels always tell us what additives are in food so I can see if it is harmful and decide whether to buy it.

**C** The children love that drink even though it contains E211. It's never harmed them up to now.

**D** I don't know if it would harm them, but I won't give the children anything containing E211.

**E** I don't believe it when they say E numbers have all passed a safety test.

Which statement **A**, **B**, **C**, **D**, or **E** is an example of the **precautionary principle**?

answer ..... [1]

[Total: 4]

**END OF QUESTION PAPER**

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